165-120 AU 3407 49210

WO 092018821 A
OCT 1992

.LLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : F28F 13/02, F28D 11/02

A1

(11) International Publication Number: WO 92/18821

(43) International Publication Date: 29 October 1992 (29.10.92)

(21) International Application Number: PCT/SE92/00254

(22) International Filing Date: 16 April 1992 (16.04.92)

(30) Priority data:
9101169-2 17 April 1991 (17.04.91) SE

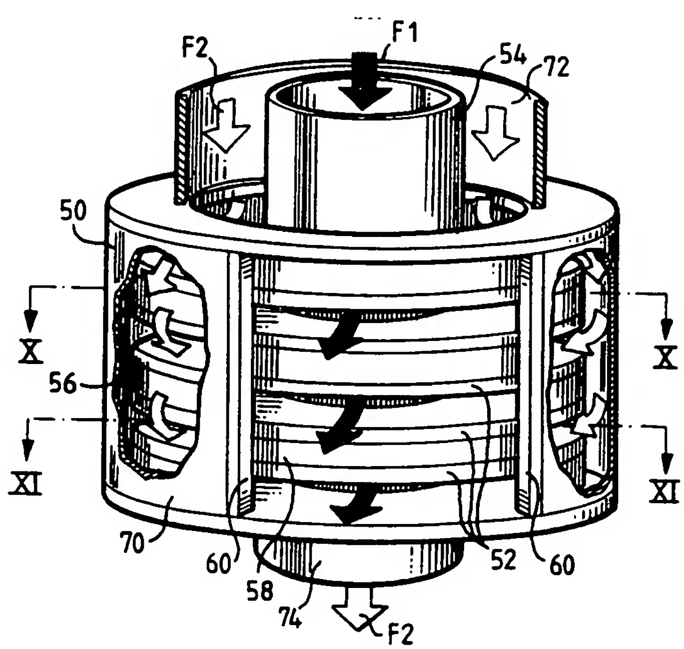
(71)(72) Applicant and Inventor: GUDMUNDSSON, Björn [SE/SE]; Porsvägen 120, S-191 48 Sollentuna (SE).

(74) Agent: SEDVALL, Bengt; B. Sedvall Patentbyrå, P.O. Box 7182, S-103 88 Stockholm (SE).

(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: METHOD AND DEVICE FOR TRANSFER OF HEAT OR MASS



(57) Abstract

A method and apparatus for the transfer of heat or mass with the aid of rotating surfaces. The fluid with which an exchange or transfer is to be made is introduced in parallel in one or more gaps or channels defined between the rotating surfaces (14; 34, 52, 84). Rotation of the surfaces causes the major part of the fluid flow to pass through a rotating, flow mechanical boundary layer adjacent the rotating transfer surface in lamellar or turbulent flow.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		
ES	Spain				

Method and device for Transfer of Heat or Mass

The present invention relates to a method of transferring heat or mass with the aid of rotating surfaces. The invention also relates to apparatus for carrying out the method.

It is known to improve the transfer of heat between a fluid and a surface, by disturbing the flow adjacent said surface, this being achieved in the case of so-called flat plate-type heat exchangers by corrugating the transfer surfaces or by providing these surfaces with turbulence-generating means.

Although this will disturb or agitate the flow of medium adjacent the surfaces, it does not induce the fluid to flow adjacent to or contiguously with the surfaces, which would improve heat transfer, but instead the fluid remains in a stationary layer close to the heat transfer surfaces, this layer having an insulating effect on the heat transfer process.

Another method of improving heat transfer is to allow the fluid to flow through narrow confined passageways, such as in the case of rotating heat-exchangers, wherein the short distance between the fluid and the wall is utilized in an endeavour to improve heat transfer. One drawback with this solution is that the major part of the fluid passes through the centre of the passageway or channel, despite the narrowness of the passageways, and thus plays a smaller role in the heat transfer process. Another drawback is that the narrow passageways are liable to become blocked, and it is often necessary to take measures to prevent blocking of the passageways, therewith making the system more expensive.

In the two cases described above, the measures taken to improve heat or mass transfer involve attempting to force into being an effect which is opposed to the intrinsic will of the fluid flow to flow in a certain manner.

US-A-4,044,824 teaches a method of exchanging heat between two fluid flows which are conducted in heat-exchange relationship with one another in a rotating heat exchanger having fluid-accommodating bellows-like pockets. The differences in the density occurring between the fluid to be cooled and the fluid to be heated is utilized to create turbulent conditions that are intended to promote the exchange of heat and the transportation of the fluids. One drawback with this known arrangement, however, is that the entire fluid flow is passed through one and the same channel out of and into the bellows-like pockets, which limits the capacity of the heat-exchanger and impairs its ability to transfer heat, since the major part of the fluid flow passes through the centre of the channel or passageway, as described above.

GB-A-936,059 teaches a heat-exchange method and a heat-exchanger which is comprised of an outer element, an inner element and an intermediate element of bellows-like form, these three elements defining therebetween two channels for the throughpass of media between which an exchange of heat shall take place. This method and the illustrated heat-exchanger have the drawbacks mentioned above with respect to the aforesaid U.S. patent specification.

Distinct from the aforedescribed known methods and apparatus, the main object of the invention is to provide a method for heat or mass transfer in which the

heat transfer index or number is improved by utilizing the natural phenomenon of flow mechanics, without disturbing the fluid flow or forcing unnatural motion onto the flow. On the basis of this object, there is proposed a method for mass and heat transfer in which very high transfer indexes or numbers are achieved.

Another object of the invention is to provide a heat and mass transfer method in which the transfer performance can be adjusted readily to desired values.

A further object of the invention is to provide a heat and mass transfer apparatus which is compact in relation to the transfer numbers or indexes obtained, since the heat and mass transfer is contingent on factors other than the size of the transfer surface.

These and other objects are achieved with the method and the apparatus having the characteristic features set forth in the following Claims.

The invention will now be described in more detail with reference to a number of exemplifying embodiments thereof and also with reference to the accompanying drawings, in which

Figure 1 is a sectional view of an apparatus for carrying out the method;

Figure 2 is a sectional view of the apparatus shown in Figure 1, taken on the line II-II;

Figure 3 illustrates the velocity distribution close to a disc which rotates in a stationary fluid;

Figure 4 illustrates a corresponding flow pattern of the disc when the fluid is delivered to the centre of the disc;

Figure 5 illustrates a corresponding flow pattern when the fluid is delivered to the periphery of the disc with

the fluid in full rotation;

Figure 6 is a vertical sectional view of another embodiment of the invention;
Figure 7 illustrates schematically the principle of the embodiment illustrated in Figure 6;
Figure 8 is a diagram showing lamellar and turbulent flow in the embodiment illustrated in Figure 7;
Figure 9 is a perspective, partially section view of one embodiment of a heat-exchanger which operates in accordance with the principles of the invention;
Figure 10 is a sectional view taken on the line X-X in Figure 9;
Figure 11 is a sectional view taken on the line XI-XI in Figure 9; and
Figure 12 is a sectional view of an apparatus for transferring mass in accordance with the principles of the invention.

The apparatus illustrated in Figure 1 comprises a number of flat discs which are mounted on a rotation shaft 10 by means of sleeves 12 and which are intended to rotate together with the shaft 10 at appropriate speeds. The shaft 10 and the discs 14 rotate in a cylindrical housing whose outer wall 16 supports a number of planar discs 18 which are attached to said wall and which project in between the first mentioned discs 14 and terminate short of the shaft 10, so as to form an interspace between the ends of the discs 18 and the shaft 10. The free edges of the discs 14 mounted on the shaft 10 and fitted to the sleeves 12 extend into a respective recess provided in the wall 16. Arranged in the recess are labyrinth seals or, with regard to fluid seals, axial seals or the like for instance, which ensure that no leakage will occur between the discs 14 and the wall 16. Arranged alternately in the wall 16 are inlets 20

and outlets 22 for delivery of a fluid to the channel or passageway defined between two discs 14 and an intermediate disc 18. It will be seen that the channel extends from the inlet 20 to a respective recess defined between the sleeves 12 and back to the outlet 22. When two mutually different fluids F_1 and F_2 are delivered to the channels, an exchange or transfer takes place between the fluids, for instance a heat transfer, without the fluids intermixing.

In the case of the Figure 1 embodiment, the inlets 20 and the outlets 22 may be located alternately in the apparatus hub and the housing wall. This arrangement will produce a counterflow effect between the fluids in which an interchange shall take place on each surface of the discs 14, 18.

By rotating the discs 14, 18 at different speeds, for instance by rotating the shaft 10 and therewith also the discs 14, an extremely efficient transfer is obtained when the greatest radial velocity component of the fluid is located in a boundary layer close to the disc surface. This rotation also generates a disc pumping effect, which can be amplified, however, by providing the disc 14 with blades 24 or vanes of appropriate configuration and angular placement, while the disc 18 may be provided with guide vanes 26. Naturally, it is also conceivable to rotate the housing wall 16 and the discs 18; the discs 14 and 18, however, may be rotated either at mutually different speeds or at mutually the same speed.

Figure 2 illustrates the delivery of the two fluids F_1 and F_2 to respective channels. Encircling the stationary housing 16 is a shell 11 which is divided by partition walls 13 into a number of riser channels 15 which form

fluid inlets and outlets. In the case of the illustrated embodiment, three inlets 20 and three outlets 22 are connected with each disc-space between the discs 14, said inlets and outlets being uniformly distributed around the periphery of the apparatus so as to obtain an equal delivery of the fluid in question, to the best possible extent. It will be understood that the number of inlets and outlets, and therewith the number of riser channels, can be varied as desired. Figure 2 is a cross-sectional view through the entire apparatus, whereas Figure 1 merely shows the right-hand half of the apparatus.

Figure 3 illustrates the flow mechanics of an infinite rotating disc in a fluid non-rotating far from the disc, and shows the velocity distribution close to the disc.

The flow pattern, or flow field, has the appearance shown in Figures 4 and 5, wherein Figure 4 illustrates the occurrence when the fluid is delivered to the centre of the disc, while Figure 5 is an illustration which shows the fluid delivered to the periphery of the disc with the fluid already in full rotation and flowing towards the centre of the disc, similar to the embodiment shown in Figure 1.

The embodiment illustrated in Figure 6 comprises a shaft 30 on which sleeves 32 are mounted, these sleeves carrying plates 34 in a manner similar to that shown in Figure 1, wherein the outer, free ends of the plates terminate against the wall 36 of a surrounding housing and are journalled in labyrinth seals, axial seals or other appropriate seals, as earlier described. Similarly, plates 38 are provided at the housing wall 36 and terminate short of the shaft 30 and the sleeves 32.

Distinct from the discs 14, 18 of the Figure 1 embodiment, the plates 34, 38 are curved to form cylindrical surfaces which are generally vertical and between which there is formed a generally vertical channel for the two media which pass through respective channels. When the shaft 30 is rotated and therewith also the plates 34, a so-called Taylor flow will occur in the channel between the plates 34 and 38, i.e. vortices and turbulence are generated which cause the medium in the channel to move between the channel surfaces and therewith improve the transfer effect, e.g. the heat transfer effect, between the two mutually isolated flowing media. This effect is greatest when the plates 34 rotate and the plates 38 are stationary, although it is also conceivable for the wall 36 to rotate in relation to the shaft 30, wherein rotation may be effected at different speeds of the plates 34 and the plates 38, or at one and the same speed.

The embodiment illustrated in Figure 6 also includes fluid inlets 40 and fluid outlets 42 and the plates 34, 38 may be provided with blades or vanes 44, 46 for guiding and pumping the media. Similar to the embodiment illustrated in Figure 1, the inlets 40 and the outlets 42 may lie alternately in the apparatus hub and in the housing wall 36, so as to obtain a counterflow effect between the fluids flowing in the channels.

In the embodiment illustrated in Figure 6, so-called Taylor vortices or eddies are generated between the vertical parts of the plates 34, 38, in the manner shown in Figure 7. According to the measurements, an axial net flow, which can be expressed by a Reynolds number, influences the circumstances for Taylor vortices, which can be expressed in a Taylor number in accordance with the diagram shown in Figure 7, where the Taylor number is plotted in relation to the Reynolds number. The best

possible transfer number, or index, is located within the area b and c of the diagram.

Figure 9 illustrates an embodiment of the invention which includes an apparatus that can, e.g., function as a heat exchanger. Mounted in a housing 50 are a number of discs 52 which extend between a central stub pipe 54 in the housing and the outer peripheral surface thereof. Each adjacent pairs of discs 52 is sectioned-off with the aid of walls 56, 58, in the illustrated embodiment in four sections, which are separated from one another radially and, with the aid of side walls 60, also peripherally. The stub connector 54 is also divided into four sections or channels 62, 64 (two of each) which are separated by mutually crossing walls 66, 68 which extend in the axial direction of the stub. The apparatus also includes vertical side walls 65, 67 which, similar to walls 56 and 58, delimit the disc space from the flows in the centre. In this way, there are formed four riser channels 62, 64 which conduct two fluids F_1 and F_2 separately through the apparatus, as described in more detail below. Two of the housing sections are separated from the housing surroundings with the aid of outer walls 70, whereas the other two housing sections are open to the housing periphery, at 76.

A first flow F_1, illustrated with solid arrows, is introduced into the central stub pipe 54 in the channel 62 and flows out over the discs towards which the channels 62 open, and then leaves the housing through the periphery 76 of the outwardly-open housing sections. The second fluid flow F_2 is introduced through a further stub pipe 72 which is concentrical with the first stub pipe 54, down over the uppermost disc 52 in the housing and is divided via the space between the walls 56 and 70 over the channels which are open to said space, and is

thereafter conducted centrally from the housing via the riser channels 64 and via a stub outlet 74. The entire apparatus is intended to rotate at a high speed, for instance a speed of 3000 r/m. Both the fluid F_1, which passes from the centre and outwards in the apparatus, and the fluid F_2, which passes in the opposite direction, are rotated when arriving over the discs 52, therewith increasing the transfer effect. The fluid F_1, which passes from the centre, is rotated because the inlet 54 functions in the manner of pump blades or vanes, while the fluid F_2 is rotated upon its entry at the periphery of the discs, this fluid rotating at a higher speed than the fluid located further in on the discs 52.

As will be understood, the discs of the Figure 9 embodiment may have the same corrugated structure as the discs of the apparatus shown in Figure 6.

Figure 12 illustrates a mass transfer apparatus, for instance an apparatus for transferring steam or water vapour to or from a salt solution from an air flow.

Arranged in a rotatable housing 80. having a centre axis 82, is a packet of discs 84 to which a salt solution is delivered with the aid of a stationary delivery pipe 86 from which the salt solution is passed through a circumferential, angle-forming ring 94 and down into several distribution pipes 88 disposed around the housing periphery and rotating together with the housing, said pipes distributing the salt solution over the discs 84. Air is blown into the housing through an opening 90 and over the disc pack 84, wherewith an exchange takes place between the air and the salt solution distributed on the discs. The salt solution leaving the discs is collected in the bottom part of a stationary hood 92, which has,

for instance, a spiral configuration and which conducts away the air exiting from the housing 80 and the discs 84, and also the salt solution.

All of the illustrated embodiments of the invention, i.e. embodiments having planar surfaces and rotating cylindrical surfaces, enable a more compact contact body to be produced whose transfer performance is achieved more by speed than by surface size. Because the flows are delivered in parallel, a large volumetric flow can be distributed over an appropriate number of discs to the extent permitted by the flow capacity of the boundary layer, so that the flow is adapted optimally, to the best possible effect, to provide the best transfer ability or transfer effect with the rotation-mechanical conditions that prevail.

Although the transfer of heat or mass has been described in the aforegoing as the transfer of heat between two fluids, it will be obvious that the inventive concept can also be applied to other forms of transfer, such as mass transfer as mentioned above with reference to Figure 12. The rotating cylindrical surface or disc surface may, for instance, comprise a catalyst or be provided with a substance, liquid or solid or like consistency, which has a chemical/physical or some other effect on one or more components of the fluid passing through the gap. The good transfer effect that prevails in the gap close to the disc surface or the cylindrical surfaces then facilitates the transfer of the components from the fluid to the surface, or vice versa.
It will also be obvious that the illustrated and described exemplifying embodiments of the invention do not limit the scope of the invention and that modifications and changes can be made within the scope of the following Claims.

C L A I M S

1. A method of effecting heat or mass transfer with the aid of rotating surfaces, c h a r a c t e r i z e d by introducing the medium or the media between which a transfer shall take place at the periphery or the centre of the rotating surfaces in several parallel gaps which are formed between said surfaces and each of which has a flow which is adapted to produce the best transfer ability, and by causing the major part of the flowing medium to pass through a rotating flow-mechanical boundary layer adjacent the rotating transfer surface in lamellar or turbulent flow, and then causing the medium to leave the gaps at the centre or periphery of said rotating surface.

2. A method according to Claim 1, c h a r a c - t e r i z e d by introducing said medium or media to the periphery of the rotating surfaces with the medium or media aleady in rotation in the rotational direction of said surfaces.

3. A method according to Claim 1, c h a r a c - t e r i z e d by introducing the medium in the centre of a gap and discharging the medium at the periphery of the rotating surfaces, or vice versa.

4. A method according to Claim 1, 2 or 3, c h a r - a c t e r i z e d by causing the rotating surfaces to rotate at mutually the same speed.

5. A method according to any one of Claims 1-4, c h a r a c t e r i z e d by adjusting the speed of the rotating surfaces so as to control the transfer effect.

6. A method according to any one of Claims 1-5, c h a r a c t e r i z e d by conducting the medium or media in sequence through several mutually adjacent gaps.

7. A method according to any one of Claims 1-6, c h a r a c t e r i z e d by introducing the medium or media into one or more gaps defined between rotating disc surfaces.

8. A method according to any one of Claims 1-6, c h a r a c t e r i z e d by introducing the medium or the media into one or more gaps defined between rotating cylindrical surfaces.

9. A method according to any one of Claims 1-6, c h a r a c t e r i z e d by introducing the medium or the media into one or more gaps defined between disc surfaces which alternate with cylindrical surfaces.

10. A method according to any one of Claims 1-6, c h a r a c t e r i z e d by introducing the medium or the media into one or more gaps defined between corrugated, alternating disc-like surfaces and cylindrical surfaces, or rounded surfaces.

11. A method according to any one of Claims 1-9, c h a r a c t e r i z e d by driving several rotating surfaces at mutually different speeds.

12. A method according to any one of Claims 1-11, when effecting a transfer between several media, c h a r - a c t e r i z e d by conducting the media in counterflow to one another in adjacent gaps.

13. A method according to any one of Claims 7-12, in which one medium is introduced at the centre of the rotating disc surfaces, c h a r a c t e r i z e d by maintaining the medium stationary or rotating the medium counter-directional to the direction of rotation of the rotating disc surfaces.

14. Apparatus for carrying out the method according to any one of Claims 1-9 for heat transfer or mass transfer, said apparatus including rotating transfer surfaces, c h a r a c t e r i z e d by at least one rotation body (16, 36, 50, 80) which is journalled on a rotation shaft (10, 30, 82) and which includes a number of mutually adjacent transfer surfaces (14, 34, 52, 84) and inlets (20, 40, 54, 72, 83) and outlets (22, 42, 76, 74, 92) for delivering one or more media parallel to the channels or interspaces formed between the transfer surfaces.

15. Apparatus according to Claim 14, c h a r a c t e r i z e d in that the transfer surfaces (14, 34) are fixed on a shaft (10, 30) which rotates in a housing (16, 36) which carries at its periphery further transfer surfaces (18, 38) which extend in between the first mentioned transfer surfaces (14, 18), and in that the inlet (20, 40) and the outlets (22, 42) are provided at the shaft or the outer periphery of the housing, or both.

16. Apparatus according to Claim 14 or 15, c h a r a c t e r i z e d in that the transfer surfaces are comprised of flat discs (14, 18).

17. Apparatus according to Claim 14 or 15, c h a r a c t e r i z e d in that the transfer surfaces are comprised of discs (34, 38) which are corrugated to form

cylindrical surfaces which extend in the axial direction of the discs, so that the channels defined between the discs are essentially axial.

18. Apparatus according to Claim 24, c h a r a c t e r i z e d in that the rotation body (50) includes a number of discs (52) which are divided into sections by means of partition walls (56, 58, 60, 65, 67, 66, 68, 70), of which sections some are connected to a central inlet (54) for a medium (F_1) which subsequent to passing over the discs leaves the rotation body (50) at its periphery (76), while remaining sections are so constructed that a second medium (F_2) is delivered separated from the central inlet (54) to the periphery of the rotation body (50) and subsequent to passage over a disc surface leaves the rotation body (50) through a centrally located outlet (74).

Fig. 1

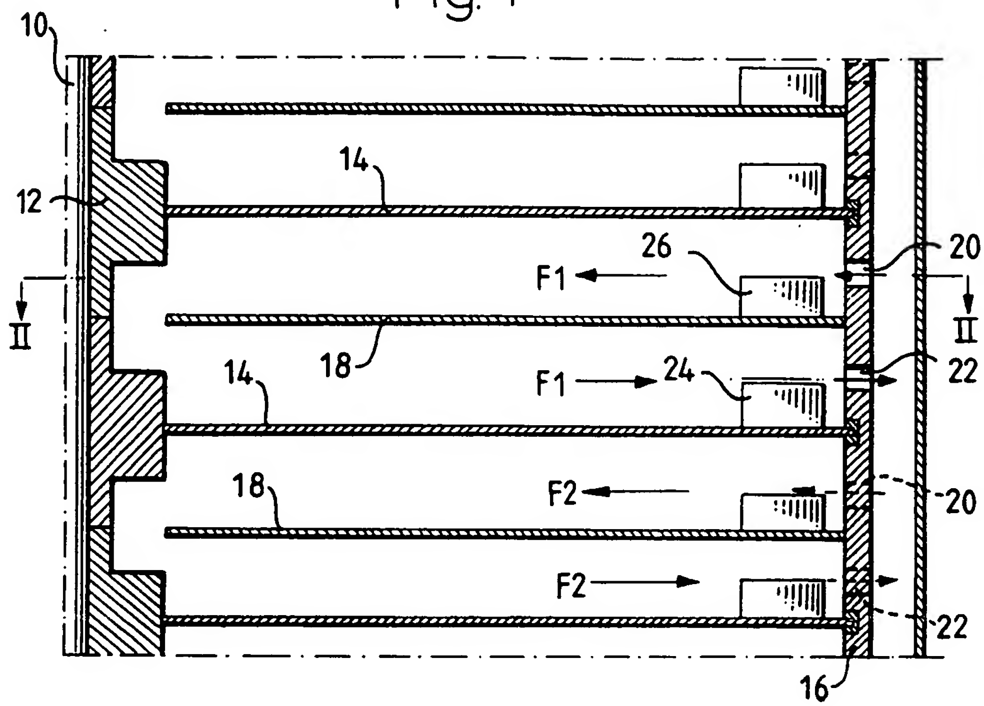

10
12
14
26
20
F1
II
II
18
F1
24
22
14
18
F2
20
F2
22
16

Fig. 2

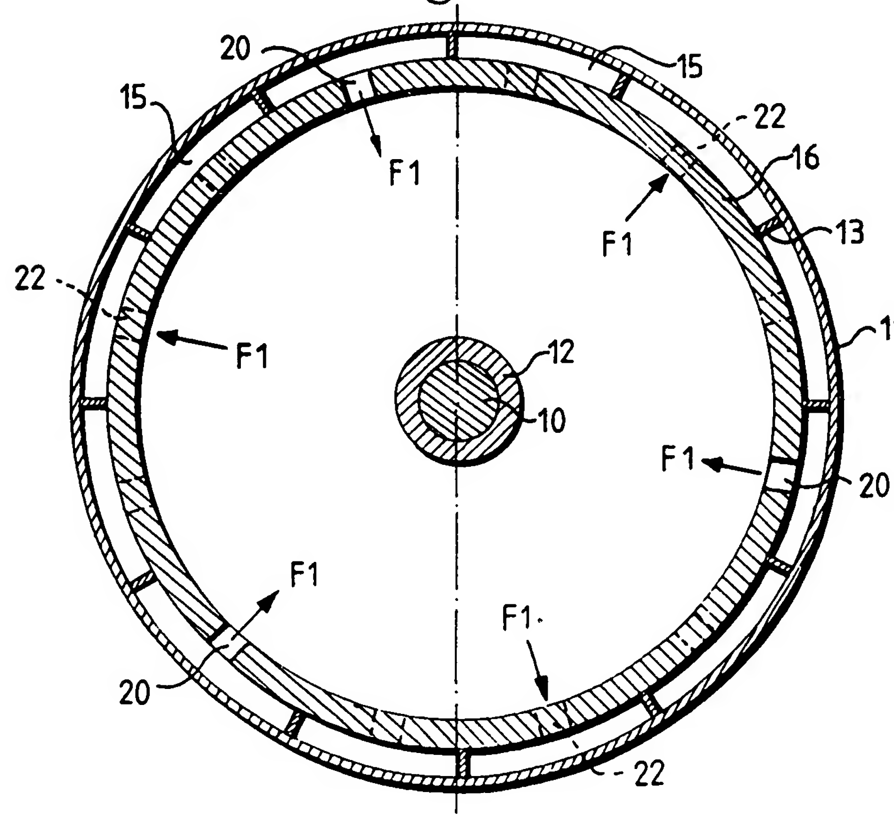

20
15
15
22
16
F1
F1
13
22
F1
11
12
10
F1
20
F1
F1
20
22

Fig. 3

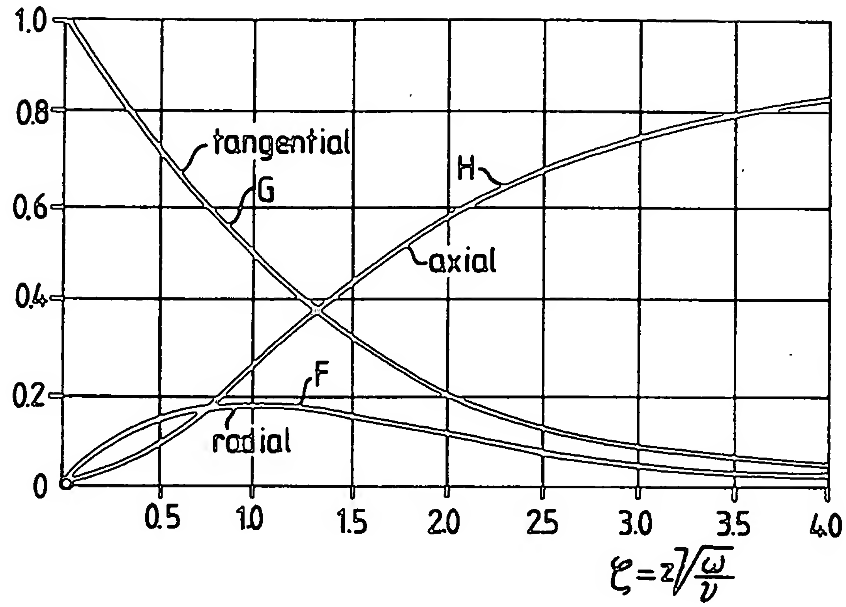

1.0
0.8
0.6
0.4
0.2
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
tangential
G
H
axial
F
radial
$\zeta = z\sqrt{\frac{\omega}{\nu}}$

Fig. 4

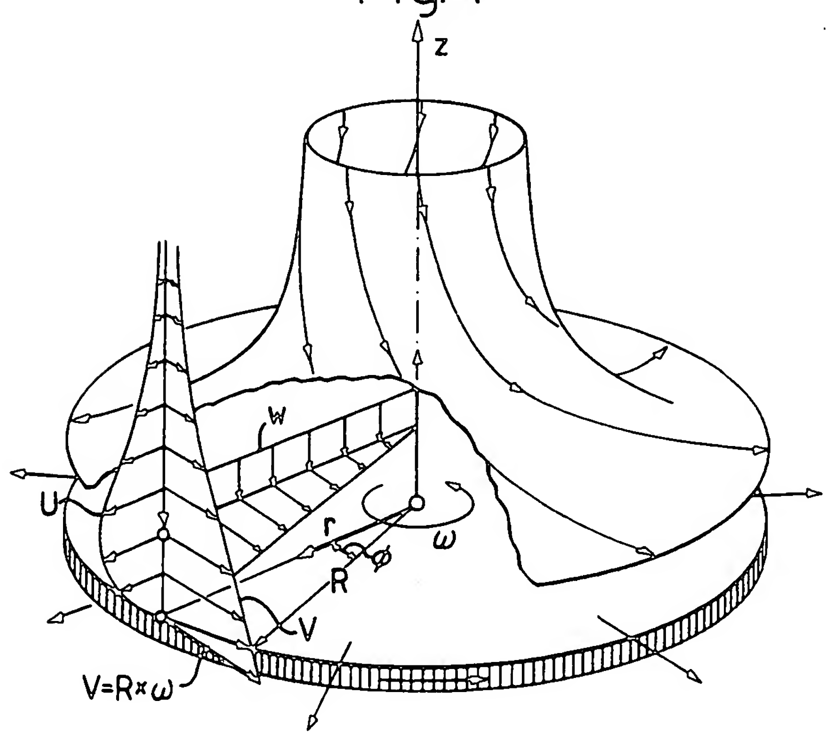

z
w
U
r
R
ω
φ
V
V=R×ω

Fig.5

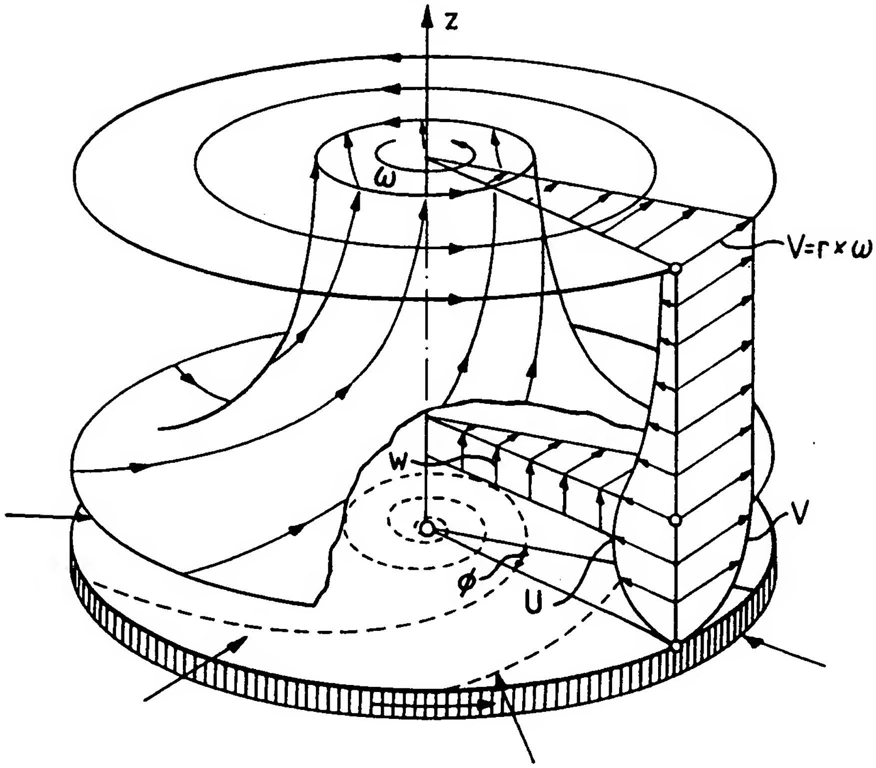


Fig. 6

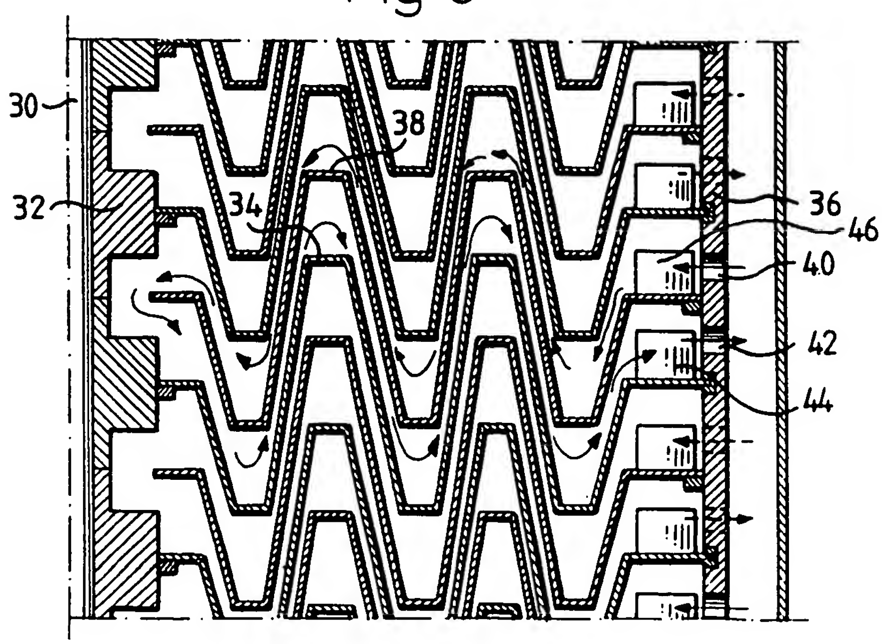


Fig. 7

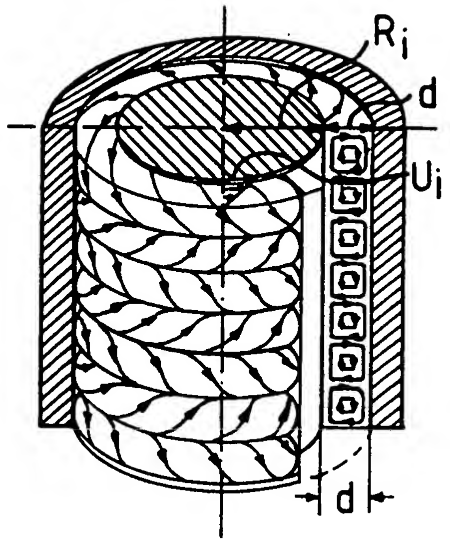

Ri
d
Ui
d

Fig. 8

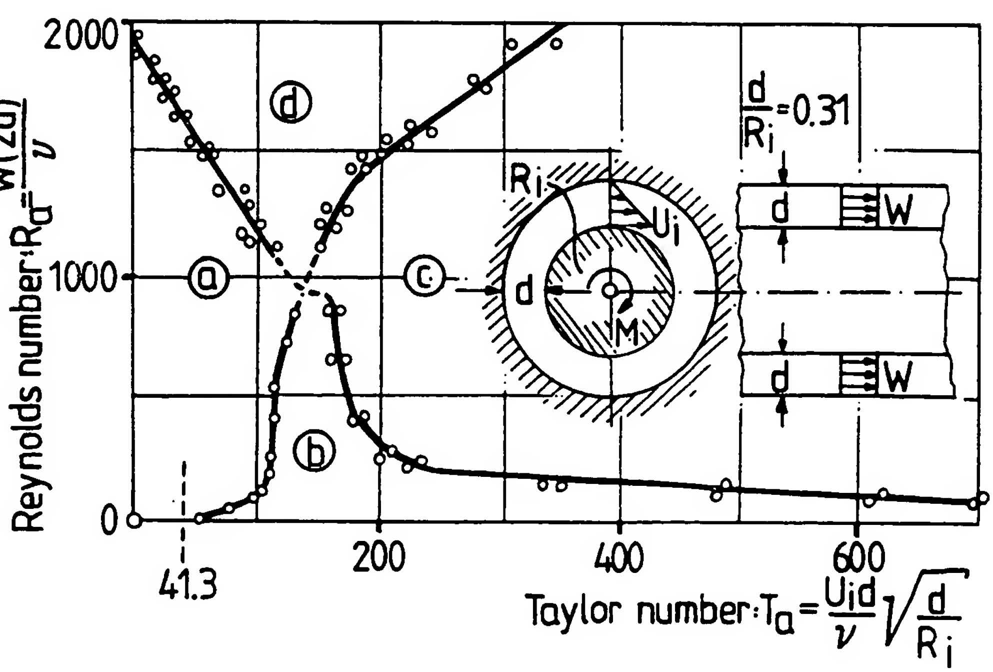

2000
1000
0
d
a
c
b
200
400
600
41.3
Reynolds number: $R_a = \frac{W(2d)}{\nu}$
Taylor number: $T_a = \frac{U_i d}{\nu}\sqrt{\frac{d}{R_i}}$
$\frac{d}{R_i} = 0.31$
Ri
Ui
d
M
W

Fig.9

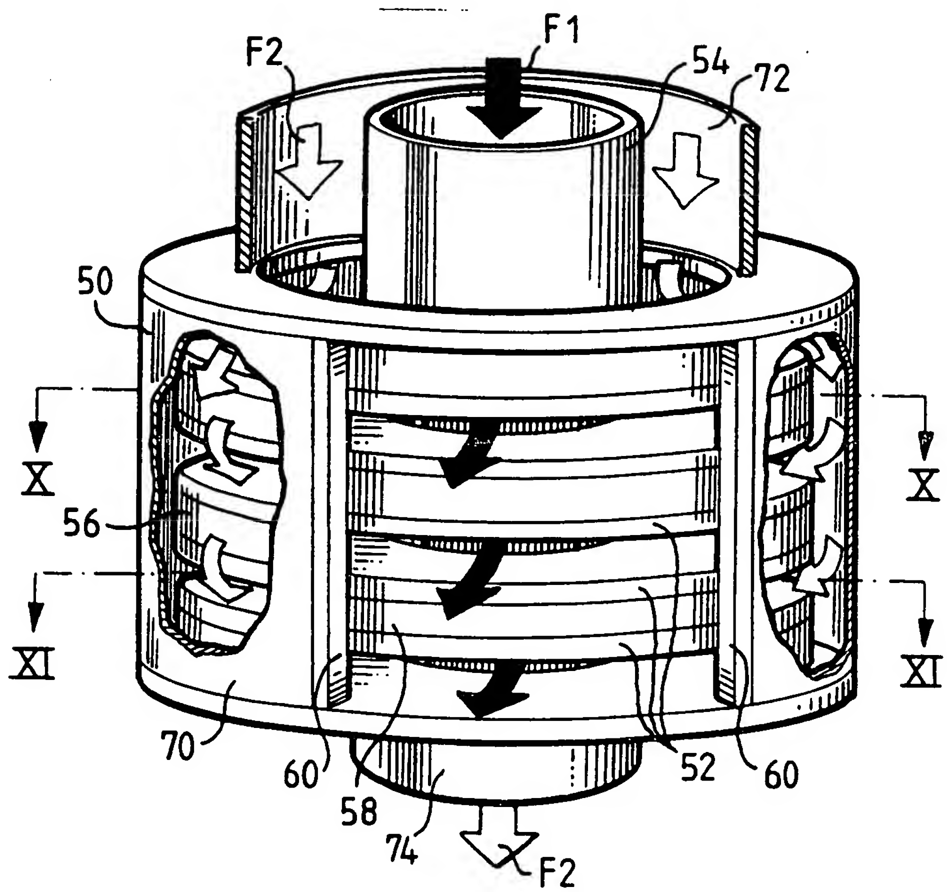


Fig. 10

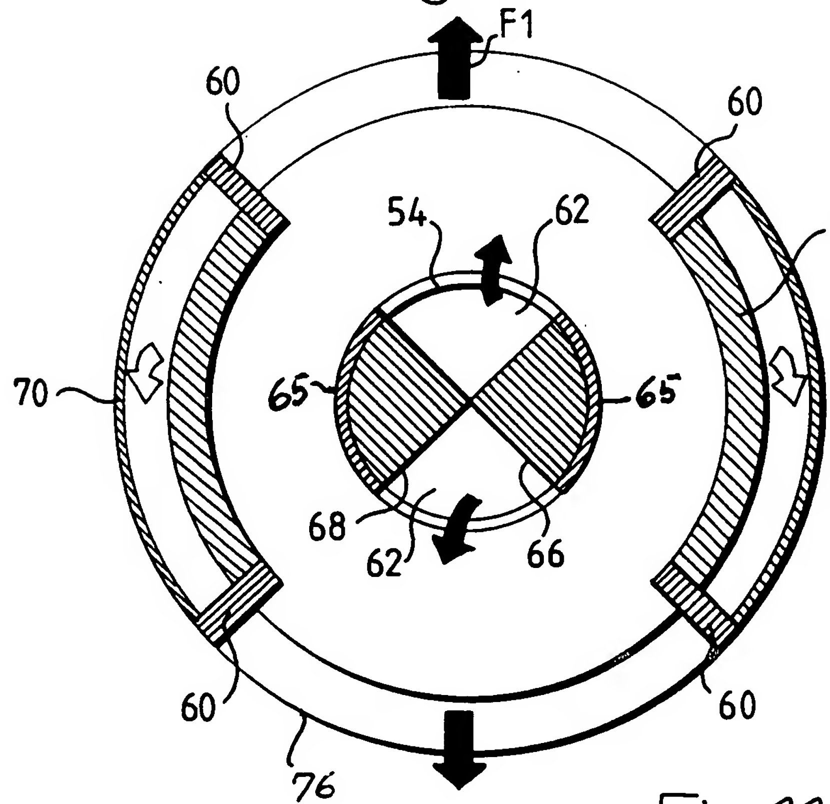

F1
60
60
54
62
56
70
65
65
68
62
66
60
60
76

Fig. 11

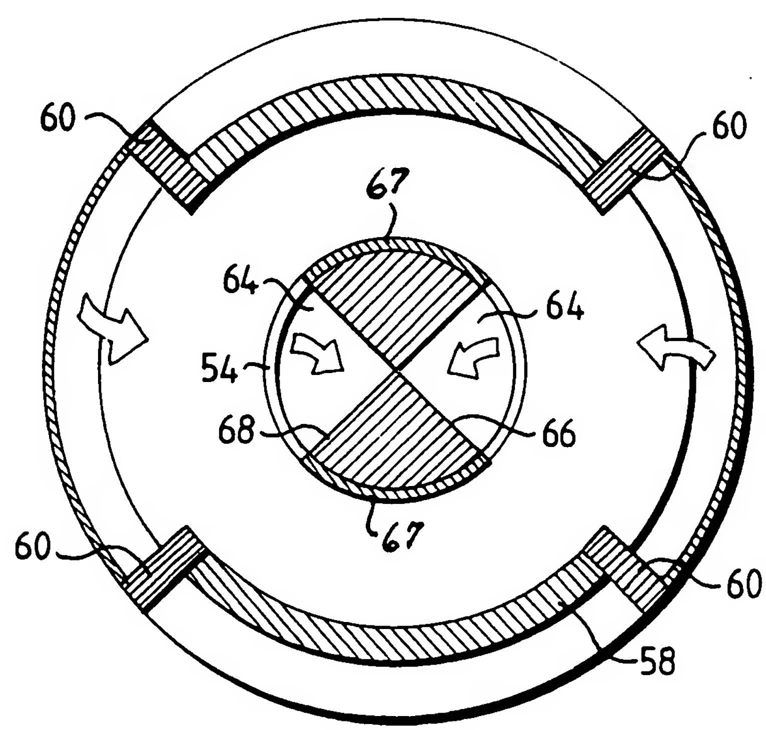
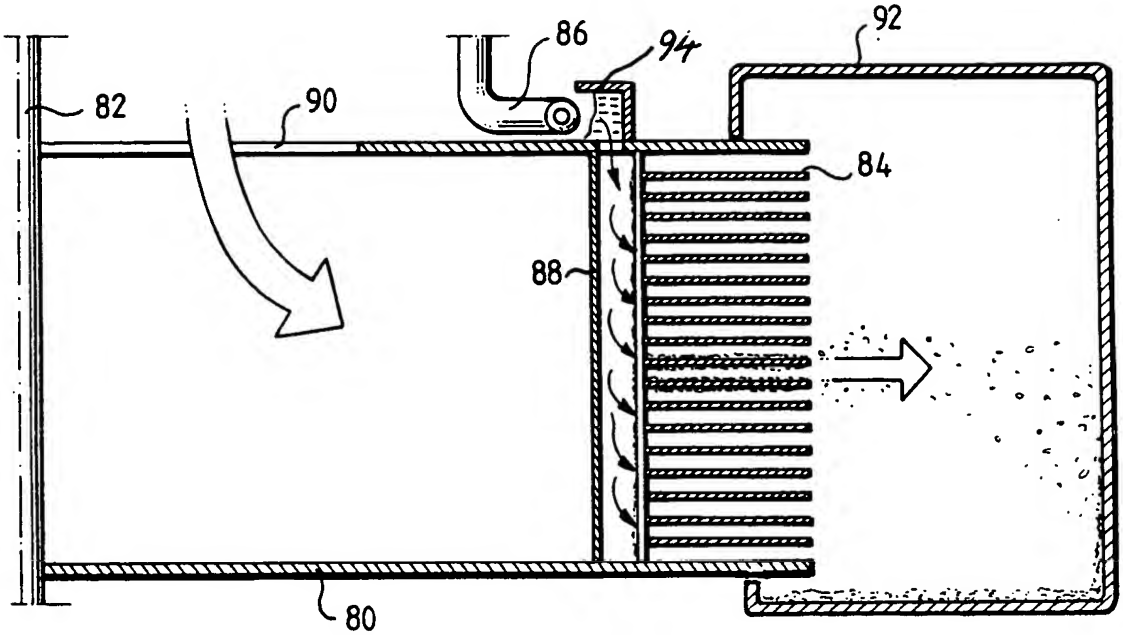

60
60
67
64
64
54
68
66
67
60
60
58

Fig. 12



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 92/00254

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 28 F 13/02, F 28 D 11/02

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	F 28 D; F 28 F; F 28 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	HEAT and TECHNOLOGY, Vol. 4, No. 2, 1986 S. Mochizuki, Wen-Jei Yang: "PERFORMANCE EVALUATION ON ROTATING DISK ASSEMBLIES BY AUTOMATED TRANSIENT TESTING METHOD", --	1-5,7, 14,16
A	US, A, 4044824 (ESKELI) 30 August 1977, see the whole document --	
A	CH, A5, 590443 (BBC AKTIENGESELLSCHAFT BROWN, BOVERI & CIE) 15 August 1977, see the whole document --	
A	GB, B, 936059 (DELANEY GALLAY LIMITED) 4 September 1963, see the whole document --	

*** Special categories of cited documents:** [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
27th July 1992	1992 -07- 29
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Anette Riedel Anette Riedel

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	DE, A1, 3608797 (KIESSLINGER, RUDOLF) 22 October 1987, see the whole document --	
A	SE 47996 (C.T. SETTERBERG) 19 June 1915, see the whole document --	
A	US, A, 3844341 (BIMSHAS, JR. ET AL.) 29 October 1974, see the whole document --	

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 92/00254

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 01/07/92
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4044824	77-08-30	CA-A- 1039518	78-10-03
		US-A- 3931713	76-01-13
		US-A- 4124993	78-11-14
CH-A5- 590443	77-08-15	DE-A- 2547710	77-04-21
GB-B- 936059	63-09-04	NONE	
DE-A1- 3608797	87-10-22	NONE	
SE- - 47996	15-06-19	NONE	
US-A- 3844341	74-10-29	NONE	